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Implementation of PS2 Remote Control and Monitoring System for Android Operating System Based Robot Platform

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Abstract: Nowadays, the security system is an important aspect in everyday life. The use of Closed Circuit Television (CCTV) has helped in controlling the security in a place but there are a few problems encountered when using it. Therefore, the development of wireless camera robot was implemented to strengthen the security system. In this study, the PS2 controller and the IP camera has been used. PS2 controller is used to control the robot movement to move either to the right, left froward or backward. Additionally, the IP camera is utilized to record the video taken on the environment. This type of camera is also using WiFi technology that allows recorded video is viewed directly when the monitoring system is underway trough the smart phone. In addition, there are two types of software used in this project experienced the Arduino IDE Software and SolidWorks Software. Robot body that has been printed is used to put the components and camera on it. Thus, the wireless camera robot can be applied to its use as a security system especially in places such as homes, schools, offices and more. In conclusion, this study presented in producing a security system that can record the state of the environment using robot technology and wireless cameras.

Key words: Mobile robot, PS2 controller, IP camera, security, technology, producing

INTRODUCTION

Nowadays, the problem of theft case is still rampant even though the matter has been curbed by the responsible person. Thefts often occurred at the school, home and office in particular even in these places be equipped by security system. For instance for the school and office buildings require the security guards to patrol a large area (Yaashuwanth *et al*., 2014; Annuar *et al*., 2012, 2016). Usually, there are only a few people guard on duty to patrol, especially at night. In this condition, it will have an impact and the effect that endanger the security guard on duty.

In addition, although, these places are often supervised by security guards but it may also occur the incidents when security guards patrolling overlooked. In addition, the use of Closed Circuit TV (CCTV) in offices, home and schools also can be installed but it is can be spoiled by a thief to remove the evidence recorded by the camera. By using the services of security guards to patrol, it is more risky to the security guard if the thieves acted to harm them.

As the introduction of robot technology, we explored about the science robot to recognize every type of robot that has been applied in a particular sector (Taher *et al*., 2016; Harun *et al*., 2015; Velrajkumar *et al*., 2017; Kapse *et al*., 2015; Ali *et al*., 2017). Therefore, by identifying every type of robot used, we can find the appropriate robot to assist in reducing the burden of the problems encountered. Nowadays, we can see the development of increasingly sophisticated technology especially for robot technology. Implementation in producing robot can be seen in various forms and functions that are beneficial to humans. Each robot has a purpose why they are produced and indirectly the technology can assist and facilitate the human works.

For this study, the robot security system was selected to develop the operation of the robot until it operates to be applied in the real world environment. The technology, is growing viewed able to help people like use robot technology to help maintain security in a particular place. In the research from Lee *et al*. (2011) the controller to make the surveillance robot moves was developed. Thus, the smartphone of android system via. wireless communication network which is WiFi system as a controller of the robot to move to desired position and acquire the real time image by using Internet Protocol Camera (IPCam).

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The surveillance robot is suitable to be applied to perform indoor patrol especially for home environment according to Chavan and Annadate (2013). Furthermore, fro this project research, the robot is able to climb the staircase for their movement and act as a system monitoring especially for security. Besides, webcam was used for record and capture the surroundings image that has been recorded.

Besides, there is development of a service robot system for a remote child monitoring platform according to Han and Seo (2014). The prototype of the service robot system is able to act as a monitoring system purpose. The robot is equipped with the web camera which is mounted on the robot body. Monitoring system operates in a real time by using smart phones (Zulkefli *et al*., 2015).

Bluetooth module was used to communicate with the mobile Bluetooth. The command was send to the robot to make it to move by using the Bluetooth module. Abdullah and Poh (2011) were mentioned the Bluetooth transceiver between microcontroller unit and mobile phone used the Bluetooth module.

Then, Shaikh *et al*. (2015) also used this wireless technology which is Bluetooth module to control the robot. In their research, the use of android application is utilized to interface with the Bluetooth and also for real time video by using WiFi technology.

The movement of the robot is operates by pressing the remote buttons in the android application. The use of the Bluetooth is the main part of component used to act as an interface between the controller and Android (Pathak *et al*., 2015; Iffat *et al*., 2015).

Another method by using GSM and the DMTF signal are work together to be applied to the robot vehicle with password protection in the research from Srivastava and Tripathi (2015). The GSM used the DMTF signal in order to control the movement of the robot. The keypad of the phone is pressed to transmit the signal to operate the robot to move.

In the research from the Azeem *et al*. (2013) used the GSM technology to give the command for controlling the robot. Besides, the gas sensor is used to detect any gas found near the robot and send to the user for the information through GSM.

Furthermore, wireless camera controlled robot is a one of the robot that has been more exposed about their technology to solve the security problem. This is due to this kind of wireless controlled robot is easier to use and control and also can save the costs. Smart phone and PS2 controller are common controller that has always be used nowadays to complete the implementation to build a robot and also the main component to control the robot. Besides, the robot is easier to move because of wireless control technology used. The wireless camera will be mounted on the robot which is controlled by the wireless controlled to meet the requirements to act as a monitoring system for security that has been applied in the home, building, school, office and so on.

The main purpose in this study will discuss development of implement the wireless controlled robot by using PS2 controller and also have the wireless camera that act as the system monitoring for the robot.

MATERIALS AND METHODS

This study will explore about the methods to be used and applied in this research to achieve all the objectives and solve the problem statement. In addition, the techniques used in the application of project will totally explain in this study.

Figure 1 show the block diagram for robot controller. The voltage supply is required to make the Arduino uno and the PS2 controller to operate. The Arduino uno will use the 12 V of voltage supply. On the other side, the PS2 controller required the 2 of batteries AAA to make it functions. The motor driver shield and PS2 shield are staked on the Arduino uno main board. So, the operational flow for the robot is started when the command form the controller sends to the PS2 shield and directs the motor to actuate. The motor will moves due to the instructions from the PS2 controller.

The block diagram Fig. 2 show wireless camera was turned on in order to produce the WiFi connection, so, that the android phone is able to connect. Hence, the plug and play Apps. that was installed in the phone is used to be able act as monitoring system which means can view the surroundings and also can capture the image.

Robot operation: The robot will be operates when it receives the instructions from the user by using the PS2 controller. The main controller used in this project is the PS2 controller. Firstly, the 12 V were supplied to the Arduino main board to make sure the operation of the robot will be function and operates. The Arduino main board was stacked with the two components which is the

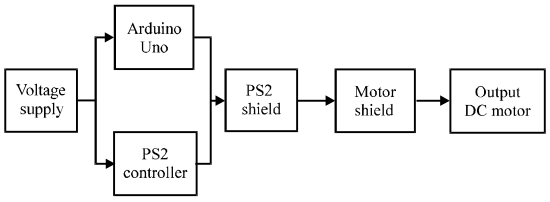

Fig. 1: Block diagram for robot controller

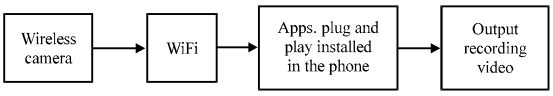

Fig. 2: Block diagram for wireless camera

Cytron PS2 shield and the 2 Amp motor shield. So, it means that the supplied from the Arduino was also transfer to these two components that were stacked.

The PS2 controller plays role as the transmitter and the on other side the PS2 adapter cable acts as a receiver of the instruction commands. The adapter cable was attached on the PS2 shield board. It will receive the status from the PS2 controller button or joystick and command from arduino board for robot operation.

Besides, the Universal Asynchronous Receiver Transmitter (UART) protocol was used as the communication interphase between the PS2 shield and the Arduino main board to get the PS2 controller status. When the commands were received by the PS2 shield board, automatically makes the robot moves due to the dc geared motor operated. The motor shield is used to make the dc geared motor function. For this project, we choose four pins of the PWM output pins since, we only use the two DC geared motor and tires. The motor shield is connecting to the motor on the right wheel and the left wheel (Fig. 3).

Camera operation: The use of the camera that will acts as a system monitoring of the robot. The WiFi connection was used to connect between the phone and the camera. When there is the connection between the phone and camera, the camera is ready to monitor the view of surroundings. But before that, the ID and password of the camera must be written in the plug and play Apps. that was installed in the phone. The App. makes the user able to record the surroundings in a real time and also able to save the video.

Besides, the camera is able to function with or without router to connect with the phone. There are two ways to make the phone connect to the camera which is the first away is the phone work without the router. Thus, the phone WiFi is direct connecting to the MD81 camera. Besides, the other way is the phone connects to the MD81 camera by using the router P2P internet in order to make the monitoring system function (Fig. 4).

Robot chassis design: For the software part, SolidWorks is used to design the chassis of the robot body. There are explanations on how to sketch the design in 3 dimensional. All the diagrams show the steps until the sketching produce the product. First step is robot body

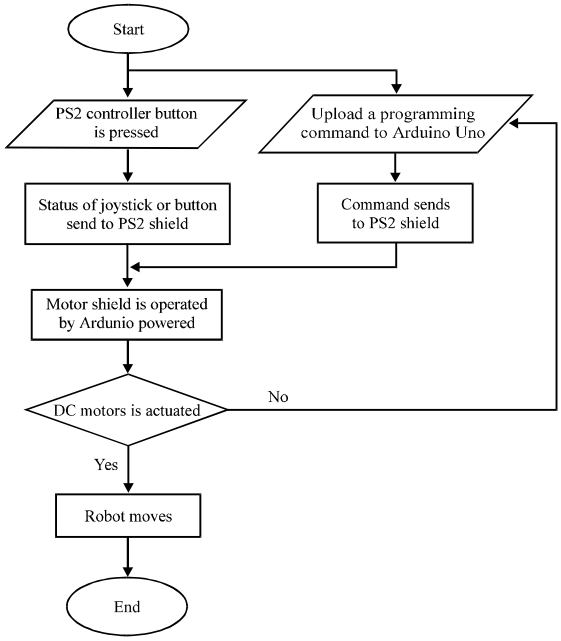

Fig. 3: Flowchart of robot operation

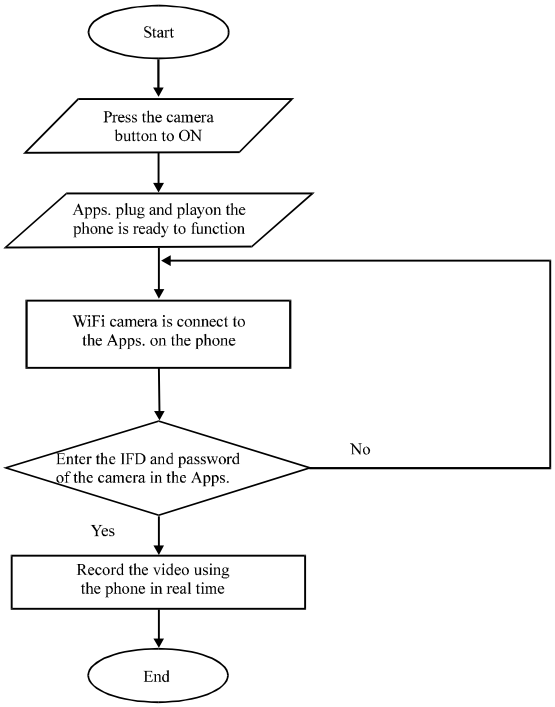

Fig. 4: Flowchart of camera operation

was sketch with the suitable dimension due to make sure all the components were fit to be mounted on the robot body. Then, extrude the drawing about 150 mm as same as the Fig. 5 shows which is the width part of the robot body.

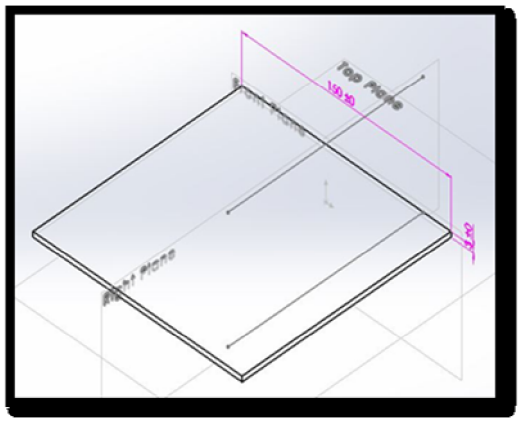

Fig. 5: Extrude the drawing

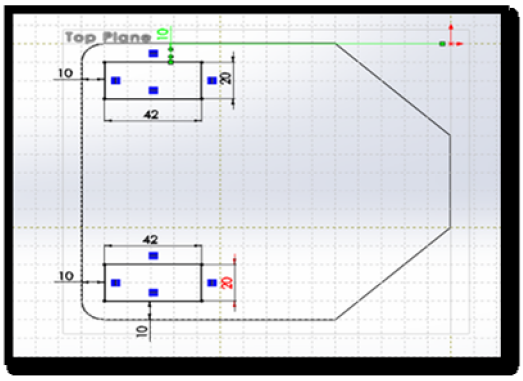

Fig. 6: Sketch the part for mounted the tire

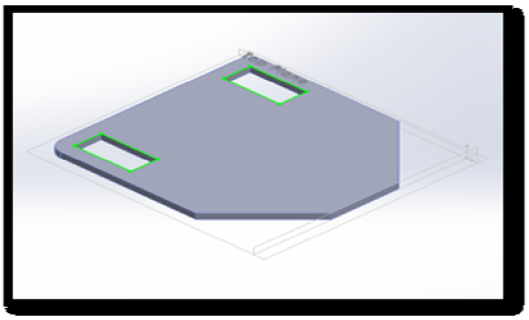

Fig. 7: Isometric view of the robot body

After that, sketch the rectangle shape on the top of the robot body by using the measurement of the dimensions of the tire (Fig. 6).

Cut extrude the draw of the rectangle shape to make the hole to put the tire for each side of the robot body. Finally, the robot body shape is like in the picture shown in Fig. 7. The 3D printer machine used to print out the body of the robot based on the sketched to put all the equipments that are used.

Fig. 8: Hardware of security robot

After all the steps for sketched the chasis are done, then the chasis will be print by using the 3D machine in order to make the appearance of the product in real form (Fig. 7). Figure 8 show final hardware of security robot system.

RESULTS AND DISCUSSION

The results that are required in this part are from the PS2 controller, IP camera and DC geared motor. The experiment test conducted to all the equipment to know how it operates. All these equipment are giving out the output when they are start running. The data from the result was recorded.

The direction and movement for the wireless robot is controlled by using the PS2 controller. There are ten inputs which are two from the right and left joystick. Then, the other eight inputs were from the buttons that represented UP, DOWN, RIGHT, LEFT, TRIANGLE, CROSS, CIRCLE and SQUARE buttons.

Before the experiment test on the PS2 controller, there is explanation of the concept on how the joysticks operate. From the Fig. 9, shows the analog format, it stated that there are two variables for each joystick, axis x and y. For example, when the user push the joystick up or down, the y-axis will change. Besides, the x-axis will be change after the user push the joystick left or right. Figure 8 views the axis of analog value format for the joysticks.

Table 1 shows the range value which is state on the joystick. There is state that the 128 value is at the middle of the joystick which is joystick in natural condition. So, the set value of 100 and 150 was used in this project to make sure that the joystick at the suitable range to give the best output. Both of the values seem that the relevant value to use it due to that value is the nearest to 128 which is the joystick in state of neutral. Hence, the joystick was pushed and passes through to the set value, the motors were operated.

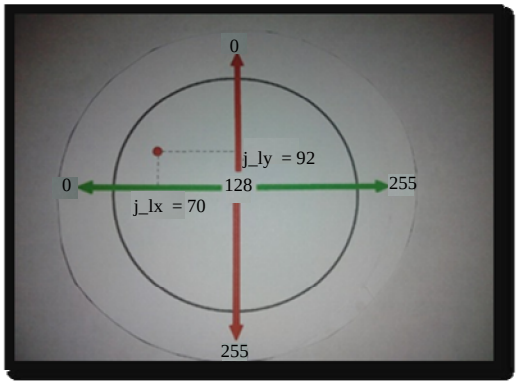

Fig. 9: Axis for analog value format

Table 1: Range value on axis for PS2 controller

Axis/Range values	Decision of joystick	Set value used in coding to operate the robot	Direction of the robot
Y			
128	Middle (neutral)	Not stated	Stationary
128 to 0	Push up	100	Forward
128 to 255	Push down	150	Backward
X			
128	Middle (Neutral)	Not stated	Stationary
128 to 0	Push to left	150	Right
128-255	Push to right	100	Left

For the first step, all of the buttons and joysticks were tested to make sure it is function when the buttons or joysticks are pressed. So, there is a coding used to prove the functionality for every button. Furthermore, PS2 controller buttons and joystick were giving out the result which is the led light up after pressed or pushed the button or joystick in this experiment test.

Then, on Fig. 10 shows the example of the coding for triangle button in order to light up the led. There is change in the coding on this "PS2. read Button (PS2_TRIANGLE) = 0" part, the "TRIANGLE" can be changed with the other word based on the buttons or joysticks that were used.

Function test: Firstly, the buttons are joysticks inputs on the PS2 controller were tested their functionality. The LED was used due to make sure that the LED light up after the buttons or joysticks were pressed or pushed. Available function are based on Table 1.

Distance test: Furthermore, the distance between the PS2 controller and PS2 shield is tested to find out the maximum distance between these two components. Moreover, PS2 is not for designed and used in long distance control. So, there are still the limit distance between the receiver and the controller parts (Fig. 11).

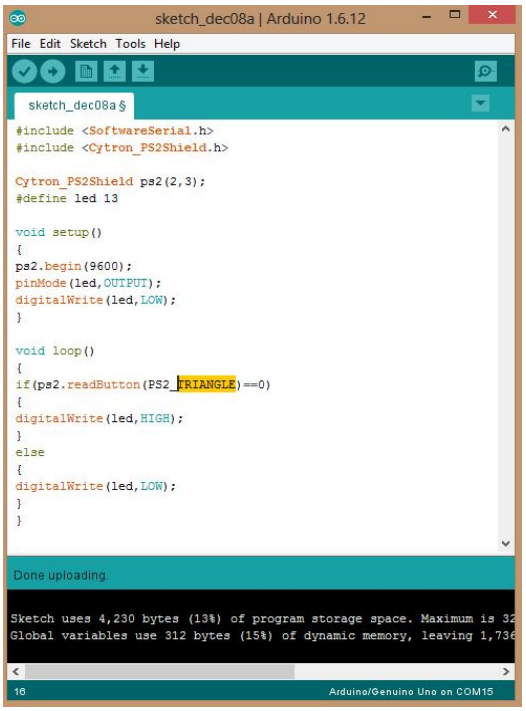

Fig. 10: Example of the coding used to light up the led

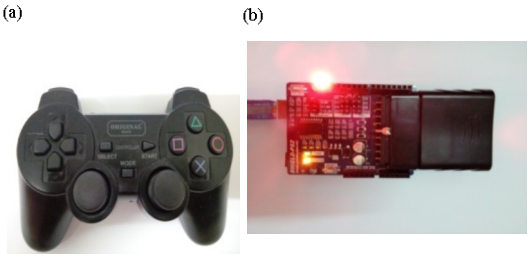

Fig. 11: a) Experiment test on the buttons or b) Joysticks from PS2 controller

Table 2: Measurement distance between the PS2 controller and PS2 shield

Distance between PS2 controller and PS2 shield (m)	Results
1	Detected
2	Detected
3	Detected
4	Detected
5	Detected
6	Detected
7	Detected
8	Not detected
9	Not detected

Besides, from the Table 2 there is also finalized that the maximum distance between the controllers to the robot is only 7 m due to that PS2 controller was designed not for long distance used.

Fig. 12: Connection between camera and Android phone

Fig. 13: Output image at bright place

Monitoring test: For the monitoring system part, World Smallest MD81s P2P Wireless IP Camera WiFi Sport Mini HD DV Camcorder DVR Recorder was used in this research. This camera is able to complete the task as to act as a monitoring system for the mobile robot. This camera is a direct monitoring from the phone. In order to connect the phone with the camera, the WiFi connection is required between these two components (Fig. 12).

The images are produced from the camera. There are few images that were captured from the camera in different conditions such as in bright or dark places. Based on the result of the image, on the bright place, image appeared properly and clearly as shown in Fig. 13. On the sides, there are no image appeared when it was tested at dark place as shown in Fig. 14.

DC gear motor test: On this part, the DC geared motor was undergoing the experiment test to make sure the

Fig. 14: Output image at dark place

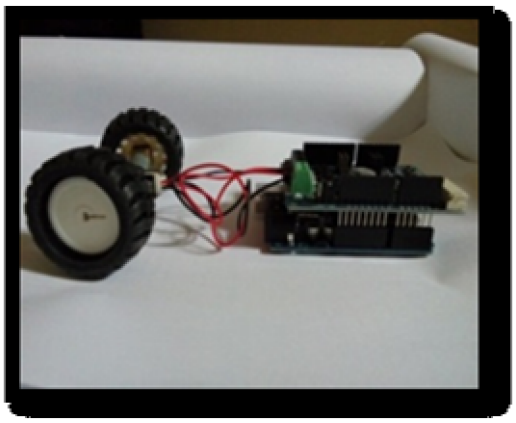

Fig. 15: Motor shield attached on the arduino board

motors were able to move. After that, the motors will give the result of the direction which are forward, backward, right or left based on the coding that was uploaded on the arduino board. Figure 15 show the DC gear motor hardware.

The experiment test for speed of DC motor for the robot was conducted due to get the time taken for the robot arrived at the checkpoint (Table 3). By using this formula, the speed of the DC geared motor is achieved:

$$\text{Speed (m/sec)} = \text{Distance (m)}/\text{Time (sec)} \quad (1)$$

Table 3: Ex eriment test on speed of motors

Distance from one point to another point (m)	Time taken to arrive at a point (sec)	Speed of DC (m/sec) geared motor
1	4.9	0.20
2	11.3	0.18
3	22.7	0.13
4	39.0	0.10
5	60.7	0.08
6	87.6	0.07
7	120.2	0.00

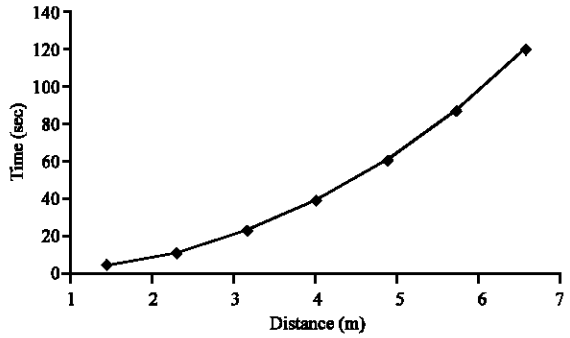

Fig. 16: Graph of distance versus time

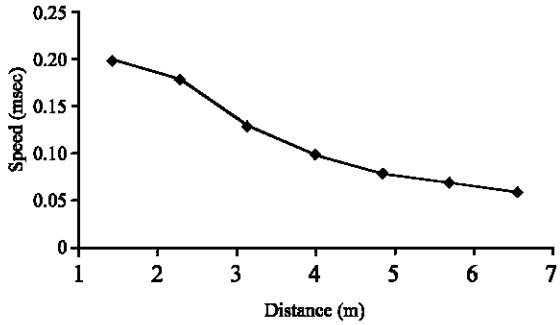

Fig. 17: Graph of distance versus speed

Based on the graphs Fig. 16 and 17, there are two relationships between distance, time and speed. The distance is held constant and directly proportional to the time taken for the robot arrived at the point. Then, the distance is remained constant and inversely proportional to the speed of the robot.

CONCLUSION

The implementation of PS2 remote control and monitoring system for android operating system based robot platform is one of the technologies that can help and assist, especially in the safety system. The PS2 controller is used to control the movement of the robot. In this project, the mechanical mechanisms that were used during conducting the project were identified and developed successfully in order to build up of one operation system. Besides, the simple wireless camera was used which is be equipped with the WiFi connection to connect to the android phone in this project to be able act as a system monitoring. For the operational flow, the PS2 controller control the direction and movement of the robot while the wireless camera mounted on the robot used to record footage that can be viewed through the phone. By using a wireless system like this, it can make easier for the users to control the movement of the robot.

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